IN THE UNITED STATES PATENT AND TRADEMARK OFFICE
BEFORE THE BOARD OF APPEALS AND INTERFERENCES

In re Patent Application of	New York, New York
Roger F. BAINES	Date: August 29, 2000
Serial No.: 07/702,615	Group Art Unit: 2834
Filed: May 17, 1991	Examiner: K. Tamai

For: ELECTRIC MOTOR WITH BRUSH ASSEMBLY SUPPORTING TWO SEPARATELY FORMED BRUSHES

Assistant Commissioner for Patents
Washington, D.C. 20231

APPEAL BRIEF UNDER 37 C.F.R. §1.192

Sir:

This Appeal concerns the propriety of the Examiner's final rejection dated December 30, 1999, in connection with the above-identified application.

STATUS OF CLAIMS:

Claims 48, 51-58, 60-67, 72, 75-79 and 93 are pending and on appeal herein.

REAL PARTY IN INTEREST:

The real party in interest is the assignee Johnson Electric S.A.

RELATED APPEALS AND INTERFERENCES:

The applicants, the assignee and the Applicants' attorneys are not aware of any related appeals and interferences.

STATUS OF AMENDMENT:

No amendments to the claims were filed after the Final Rejection dated December 30, 1999.

SUMMARY OF INVENTION

The invention relates to an improvement in a brush assembly for a DC electric motor (Fig. 1) which has a commutator 12 with a plurality of separate, circumferentially-arranged segments. Electrical contact between a power supply circuit and the commutator is provided by at least one brush which is supported by a brush arm. In the invention, the brush-commutator interface resistance is reduced by a new, advantageous feature not seen in the prior art; namely, a brush assembly having a pair of brushes 20, 21 which are electrically in parallel, are spaced axially along the length of the commutator, and have different mechanical resonant frequencies. See, for example, the pair of brushes 20, 21 on the left side of Fig. 2.

The pair of brushes 20, 21 are disposed for contacting the commutator simultaneously; or in other words, they are adjacent the same given segment of the commutator at a given point in time.

A pair of parallel brushes on the same side of the commutator is known per se, as shown for example in Watanabe, U.S. Patent 4,086,510. The conventional way of improving the electrical contact between such brushes and the commutator is simply to increase the pressure of the brushes on the commutator, which increases wear and power loss due to heat. In contrast, according to the invention, improved electrical contact can be obtained by providing the brushes 20, 21, combined with their respective supporting parts 18, 19, with different respective mechanical resonant

frequencies. Thus, even if there is some bouncing of the brushes with respect to the commutator, the respective bounces of the two brushes will occur at different points in time due to their different resonant frequencies, so it is likely that at least one brush will be in contact with the commutator at all times. Further, if the motor speed corresponds to the resonant frequency of one brush, it will not correspond to that of the other brush, so the other brush will be less likely to lose contact with the commutator. Page 5, lines 2-7. Thus the brush-commutator interface electrical resistance is reduced, improving current conduction.

The different resonant frequencies of the brushes may be obtained in several different ways. The brushes may have different weights or densities. Slots, apertures, or narrow portions (see Fig. 3A) may be formed in the brush arms. Various claims are directed to different structures that provide the different resonant frequencies.

A second pair of brushes may be arranged for contacting the commutator at a location diametrically opposite the first pair of brushes. The second pair of brushes are termed "third and fourth brushes" and they are supported on "third and fourth support arms," according to some of the claims. The "first and second" supporting parts and brushes are on the left side of Fig. 2. The "third and fourth" elements are on the right side of Fig. 2. Again, the third and fourth brushes are spaced axially along the commutator so they are capable of substantially simultaneously contacting a single respective segment of the commutator. And again, it is disclosed to be highly advantageous for the third and fourth brushes to have different resonant frequencies in combination with their respective support arms.

Issues

1. Whether claims 48, 51-58, 60-67, 72 and 75-79 are unpatentable under 35 U.S.C. §103(a) over Mabuchi '450 (Japanese Patent 59-230450) and Mabuchi '953 (Japanese Patent 62-293953); and

2. Whether claim 93 is unpatentable under 35 U.S.C. §103(a) over JP 59-30672 ('672) over Mabuchi '450 and Mabuchi '953.

Grouping of Claims

1. Claims 48, 51-58, 60-67, 72 and 75-79 "stand or fall" together; and

2. Claim 93 "stands or falls" by itself.

Argument

ISSUE 1 Whether claims 48, 51-58, 60-67, 72 and 75-79 are unpatentable under 35 U.S.C. §103(a) over Mabuchi '450 (Japanese Patent 59-230450) and Mabuchi '953 (Japanese Patent 62-293953)

Claims 48, 51-58, 60-67, 72 and 75-79 are directed to an electric motor brush assembly for mounting in a DC electric motor, which includes, *inter alia*, first and second resilient, electrically conductive support arms arranged for being axially spaced from each other with respect to a longitudinal axis of the DC electric motor when the assembly is mounted in the motor. The first and second support arms have different respective resiliencies so as to have different resonant frequencies which result from parts of the first and second support arms being made of different materials.

Mabuchi '450 and '672 (collectively, "Mabuchi") teach a motor having two sets of diametrically opposed brush assemblies where each brush assembly contains two brushes. Each brush has a support arm.

As recognized by the Examiner, Mabuchi does not teach that each support arm should have a different resonant frequency due to different materials in the brush arm.

Further, although the Examiner contends that Mabuchi has a brush body, in fact, it does not.

Mabuchi is directed to fingerleaf brushes (which do not have brush bodies), while claims 48, 51-58, 60-67, 72 and 75-79 are directed to a brush assembly of a type having support arms, with "each arm carrying a respective brush body ...." That is, the present invention concerns

not fingerleaf brushes, but carbon leaf brushes. Contrary to the Examiner's argument, fingerleaf brushes are in a separate class from carbon leaf brushes and carbon cage brushes. They are very different in construction and application.

Fingerleaf brushes make a different type of contact with the commutator and are used in very low current applications, usually with motors of low life expectancy. In special applications, precious metal such as palladium-silver, silver or gold may be inlaid into the material of the fingerleaf to provide a longer lasting, harder contact area or a lower contact resistance and are often used with commutators of similar material. Contact resistance is important, as voltages are often low and the brush pressure is very low in order to reduce brush wear which is significant due to the metal-to-metal contact. Also, the motors are physically very tiny.

Carbon leaf brushes are used in bigger motors because of their physical size. They are also used in higher current applications and have copper or carbon segment commutators requiring a softer contact material to give satisfactory life expectancy. However, wear rate is traded against contact resistance as both are affected by brush pressure, which for a carbon leaf brush is significant.

Contrary to the Examiner's assumption, a skilled person would not assume that an advance in fingerleaf brushes would be applicable to carbon leaf brushes as well. Although they usually have a common leaf base material of beryllium copper, all other aspects are different, as shown in the following table:

	Fingerleaf brushes	Carbon leaf brushes
Contact material	metal	carbon
Spring/brush pressure	very light	heavy
Life expectancy	low	low to high, depending on conditions
Brush size	tiny	small
Brush contact	multiple fingers	single carbon brush

(In the table, qualitative terms such as "tiny" and "small" have well-defined meanings among those working in the art.)

In order to attempt to use carbon to make multiple contacts with a commutator (perhaps after seeing a prior art multi-contact fingerleaf brush), the skilled person would not utilize <u>multiple carbon brushes</u> as claimed herein. Rather, the skilled person would follow the conventional wisdom and modify <u>a single carbon brush</u> by forming fine ridges in the contact face. Thus, the prior art would not suggest the structure now claimed.

Further, the skilled person would be skeptical of the idea of using carbon to form multiple contacts with the commutator. In the type of carbon brush just mentioned, the fine ridges in the contact face would be expected to lead to a faster bed-in of the carbon brush, leading quickly to formation of one large contact surface, rather than many fine contact surfaces. The skilled person would believe fingerleaf brushes to be superior, since the metal-to-metal contact of the fingerleaf brush does not "bed in," but rather, wears out.

This is the first time carbon leaf brushes have been used in parallel. This is not shown in the prior art cited and it is not appropriate to suggest that it is obvious to make a carbon leaf brush assembly in the form of a fingerleaf brush.

Accordingly, it is respectfully submitted that claims 48, 51-58, 60-67, 72 and 75-79 are patentable over Mabuchi '450 and '953.

<u>ISSUE 2</u> <u>Whether claim 93 is unpatentable under 35 U.S.C. §103(a) over JP 59-30672 ('672) over Mabuchi '450 and Mabuchi '953</u>

Claim 93 is directed to an electric motor brush assembly for being mounted in a DC electric motor, which includes, *inter alia*, first and second resilient, electrically conductive support arms arranged for being axially spaced from each other with respect to a longitudinal axis of the DC electric motor when the assembly is mounted in the motor. Each of the support arms is connected in parallel and each support arm has a different respective natural resonance frequency of oscillation.

JP '672, like Mabuchi '450 and Mabuchi '953, is directed to carbon leaf brushes rather than finger leaf brushes. As discussed above in connection with Issue 1, finger leaf brushes and carbon brushes are so different that one skilled in the art would not use multiple carbon brushes,

as claimed in the present application. Accordingly, it is respectfully submitted that claim 93 is patentable over the references.

In view of the foregoing, it is respectfully submitted that all of the claims on appeal are patentable over the references. Accordingly, it is respectfully requested that the decision of the Examiner finally rejecting claims 48, 51-58, 60-67, 72, 75-79 and 93 be reversed and that this application be passed to issue.

The Claims on Appeal Are:

48. An electric motor brush assembly for being mounted in a DC electric motor, comprising:

first and second resilient, electrically conductive support arms arranged for being axially spaced from each other with respect to a longitudinal axis of said DC electric motor when said assembly is mounted in the motor,

the support arms being connected electrically in parallel,

each arm carrying a respective brush body, said brush bodies being arranged for contacting a generally cylindrical commutator of the motor,

the commutator having a plurality of circumferential segments and the first and second brush bodies being capable of contacting a single one of said segments simultaneously when the assembly is mounted in the motor,

each arm in combination with the respective brush body thereof having a different respective natural resonance frequency of oscillation;

wherein said first and second support arms have different respective resiliencies so as to have said different frequencies;

wherein parts of said first and second support arms are made of different materials so as to provide said different respective resiliencies.

51. A brush assembly as in claim 48, wherein each said brush body is mounted by an interference fit in an aperture in the respective support arm thereof.

52. In combination, an electric motor brush assembly and a DC electric motor, the brush assembly comprising:

first and second resilient, electrically conductive support arms arranged for being axially spaced from each other with respect to a longitudinal axis of said DC electric motor when said assembly is mounted in the motor,

the support arms being connected electrically in parallel,

each arm carrying a respective brush body, said brush bodies being arranged for contacting a generally cylindrical commutator of the motor,

the commutator having a plurality of circumferential segments and the first and second brush bodies being capable of contacting a single one of said segments simultaneously when the assembly is mounted in the motor,

each arm in combination with the respective brush body thereof having a different respective natural resonance frequency of oscillation;

wherein said first and second support arms have respective portions made of different resilient materials, thereby providing said different resonant frequencies; and

said direct current electric motor comprising

said generally cylindrical commutator, and said first and second brush bodies being in contact therewith.

53. A brush assembly as in claim 43, wherein said two brush bodies, having said different resonant frequencies, remain in reliable electrical contact between said first and second support arms and said commutator, thereby reducing interface resistance between the brush bodies and the commutator, despite oscillations of said arms and brush bodies which occur in response to rotation of said commutator.

54. A brush assembly as in claim 48, further comprising:

third and fourth resilient, electrically conductive support arms arranged for being axially spaced from each other with respect to said longitudinal axis of said DC electric motor when said assembly is mounted in the motor, said third and fourth support arms being connected electrically in parallel, and carrying respective third and fourth brush bodies which are arranged for contacting said generally cylindrical commutator of the motor, the commutator having a plurality of circumferential segments and the third and fourth brush bodies being capable of contacting a single one of said segments simultaneously when the assembly is mounted in the motor.

55. A brush assembly as in claim 54, wherein said third and fourth support arms in combination with the respective brush bodies thereof have different respective natural resonance frequencies of oscillation.

56. A brush assembly as in claim 55, wherein said third and fourth brush bodies, having said different resonant frequencies, remain in reliable electrical contact between said third and fourth support arms and said commutator, thereby reducing interface resistance between the brush bodies and the commutator, despite oscillations of said arms and brush bodies which occur in response to rotation of said commutator.

57. A brush assembly as in claim 54, wherein the third and fourth brush bodies are substantially diametrically opposite the first and second brush bodies with respect to said motor axis.

58. In combination, an electric motor brush assembly and a DC electric motor, the brush assembly comprising:

first and second resilient, electrically conductive support arms arranged for being axially spaced from each other with respect to a longitudinal axis of said DC electric motor when said assembly is mounted in the motor,

the support arms being connected electrically in parallel,

each arm carrying a respective brush body, said brush bodies being arranged for contacting a generally cylindrical commutator of the motor,

the commutator having a plurality of circumferential segments and the first and second brush bodies being capable of contacting a single one of said segments simultaneously when the assembly is mounted in the motor,

each arm in combination with the respective brush body thereof having a different respective natural resonance frequency of oscillation;

wherein said first and second support arms have respective portions made of different resilient materials, thereby providing said different resonant frequencies; and

third and fourth resilient, electrically conductive support arms arranged for being axially spaced from each other with respect to said longitudinal axis of said DC electric motor when said assembly is mounted in the motor, said third and fourth support arms being connected electrically in parallel, and carrying respective third and fourth brush bodies which are arranged for contacting said generally cylindrical commutator of the motor, the commutator having a plurality of circumferential segments and the third and fourth brush bodies being capable of contacting a single one of said segments simultaneously when the assembly is mounted in the motor;

said direct current electric motor comprising

said generally cylindrical commutator, and said third and fourth brush bodies being in contact therewith.

60. A brush assembly as in claim 72, wherein said supports are connected electrically in parallel with each other, and are arranged in the assembly for being axially spaced from each other with respect to said longitudinal axis of said motor.

61. A brush assembly as in claim 60, further comprising an end cap, said supports being mounted on said end cap, said brushes being mounted on said end cap via said supports for contacting the commutator of the motor, said commutator having a circumference, and said brushes being mounted so as to be at substantially a common position around said circumference.

62. A brush assembly as in claim 61, wherein said commutator has a plurality of circumferential segments and said first and second brushes are mounted so as to be capable of contacting a common one of said segments simultaneously.

63. A brush assembly as in claim 61, further comprising third and fourth supports mounted on said end cap and third and fourth brushes mounted on said end cap via said third and fourth supports for contacting the commutator of the motor, and said third and fourth brushes being mounted so as to be at substantially a common position around said circumference, said common position being different from the common position of said first and second brushes.

64. A brush assembly as in claim 63, said third support and brush having a third resonant frequency, said fourth support and brush having a fourth resonant frequency, and said third and fourth resonant frequencies being different.

65. A brush assembly as in claim 64, wherein said third and fourth brush bodies, having said different resonant frequencies, remain in reliable electrical contact between said third and fourth supports and said commutator, thereby reducing interface resistance between the brushes and the commutator, despite oscillations of said supports and brushes which occur in response to rotation of said commutator.

66. A brush assembly as in claim 63, wherein said commutator has a plurality of segments and said third and fourth brushes are mounted so as to be capable of contacting a common one of said segments simultaneously.

67. A brush assembly as in claim 63, wherein the first and second brushes are substantially diametrically opposite the third and fourth brushes with respect to said motor axis.

72. An electric motor brush assembly mounted in a DC electric motor, said brush assembly comprising:

first and second resilient, electrically conductive brush supports, the supports carrying respective first and second brushes which are thereby arranged for contacting a generally cylindrical commutator of the motor;

the supports being mounted to a common base which is spaced from a longitudinal axis of the motor and the brushes extending toward a common circumferential region of said commutator;

said first support and brush having a first resonant frequency, said second support and brush having a second resonant frequency, and said first and second resonant frequencies being different;

wherein a portion of said first support has a different resiliency than a corresponding portion of said second support for causing said first frequency to be different from said second frequency;

wherein said portions of said supports are made of different resilient materials, thereby having said different resiliencies.

75. A brush assembly as in claim 72, wherein each said brush is mounted by an interference fit in an aperture in the respective support thereof.

76. A brush assembly as in claim 72, wherein said first and second brush bodies, having said different resonant frequencies, remain in reliable electrical contact between said first and second supports and said commutator, thereby reducing interface resistance between the brushes and the commutator, despite oscillations of said supports and brushes which occur in response to rotation of said commutator.

77. An electric motor brush assembly for being mounted in a DC motor comprising:

first and second resilient, electrically conductive supports arranged for being mounted in such motor, the supports carrying respective first and second brushes which are thereby arranged for contacting a commutator of such motor when the assembly is mounted in the motor;

the supports being axially spaced from each other along said axis of said motor;

said first support and brush having a first resonant frequency, said second support and brush having a second resonant frequency, and said first and second resonant frequencies being different;

wherein said first and second supports have respective portions made of different resilient materials, thereby providing said different resonant frequencies.

78. In combination, an electric motor brush assembly and a DC motor, said brush assembly comprising:

first and second resilient, electrically conductive supports arranged for being mounted in the motor, the supports carrying respective first and second brushes which are thereby arranged for contacting a commutator of the motor when the assembly is mounted in the motor;

the supports being axially spaced from each other along said axis of said motor;

said first support and brush having a first resonant frequency, said second support and brush having a second resonant frequency, and said first and second resonant frequencies being different;

wherein said first and second supports have respective portions made of different resilient materials, thereby providing said different resonant frequencies; and

said direct current electric motor comprising

said commutator, said commutator being generally cylindrical, and said first and second brushes of the brush assembly being in contact therewith.

79. A brush assembly as in claim 78, wherein said commutator has a plurality of circumferential segments and said first and second brushes are mounted so as to be capable of contacting a common one of said segments simultaneously.

93. An electric motor brush assembly for being mounted in a DC electric motor, comprising:

first and second resilient, electrically conductive support arms arranged for being axially spaced from each other with respect to a longitudinal axis of said DC electric motor when said assembly is mounted in the motor,

the support arms being connected electrically in parallel,

each arm carrying a respective brush body, said brush bodies being arranged for contacting a generally cylindrical commutator of the motor, the commutator having a plurality of circumferential segments and the first and second brush bodies being capable of contacting a single one of said segments simultaneously when the assembly is mounted in the motor,

each arm in combination with the respective brush body thereof having a different respective natural resonance frequency of oscillation.